DOCUMENT RESUME

ED 306 910 HE 022 635

TITLE School-University Mathematics (SUM) Program.
INSTITUTION American Association of State Colleges and Universities, Washington, D.C.; Virginia Commonwealth Univ., Richmond.
PUB DATE 88
NOTE 18p.; This report is one of a group gathered by the AASCU/ERIC Model Programs Inventory Project, funded by the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education. For related documents, see HE 022 565-617, HE 022 619-643 and HE 022 645-659.
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS College Faculty; *College School Cooperation; *Faculty Development; Higher Education; Inservice Teacher Education; Mathematics Curriculum; Mathematics Instruction; *Mathematics Teachers; Models; Program Descriptions; *Secondary School Teachers; State Universities; Summer Programs; Teacher Improvement
IDENTIFIERS *AASCU ERIC Model Programs Inventory Project; *Virginia Commonwealth University

ABSTRACT

Virginia Commonwealth University's School-University Mathematics (SUM) program, described in this report, is designed to foster collegial relationships between university faculty and secondary mathematics teachers via summer mathematics colloquia, academic year collaborative inservice courses, and a Mathematics Teacher-in-Residence program. SUM was developed in response to the needs of certified secondary school mathematics teachers in Virginia for: more in-service training in areas of math that are of increasing importance; more opportunities for their professional growth as mathematicians and teachers of math; and mechanisms to encourage secondary school teachers to play leadership roles in collegial, ongoing programs. In the Mathematics Colloquia, secondary teachers and university faculty learn together to play leadership roles in the math community by developing presentations, writing journal articles, and planning the cooperative in-service courses for teachers. The Teacher-in-Residence program features an academic year's university residency for a secondary teacher who studies a new area of mathematics, teaches university mathematics classes, directs student teachers, and promotes curriculum articulation between university and secondary schools. The outcome of this program, which will serve 150 people, will be evaluated and analyzed for potential effectiveness as a national model. Appended is a description of the Mathematics Teacher-in-Residence program. (Author/SM)

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SCHOOL-UNIVERSITY MATHEMATICS (SUM) PROGRAM

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AASCU/ERIC Model Programs Inventory Project

The AASCU/ERIC Model Programs Inventory is a two-year project seeking to establish and test a model system for collecting and disseminating information on model programs at AASCU-member institutions--375 of the public four-year colleges and universities in the United States.

The four objectives of the project are:

- To increase the information on model programs available to all institutions through the ERIC system
- To encourage the use of the ERIC system by AASCU institutions
- To improve AASCU's ability to know about, and share information on, activities at member institutions, and
- To test a model for collaboration with ERIC that other national organizations might adopt.

The AASCU/ERIC Model Programs Inventory Project is funded with a grant from the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education at The George Washington University.

ABSTRACT

Virginia Commonwealth University's School-University Mathematics (SUM) program fosters collegial relationships between university faculty and secondary mathematics teachers through week-long summer mathematics colloquia, academic year collaborative in-service courses, and a Mathematics Teacher-in-Residence program.

In the Mathematics Colloquia, secondary teachers and university faculty work and learn together to play leadership roles in the mathematics community by developing presentations, writing journal articles, and planning the cooperative in-service courses for teachers. The 1988 Colloquium brought together secondary teachers and university faculty from three other regions around the state to work with Richmond area teachers and Virginia Commonwealth University faculty to initiate or enhance SUM interaction in their locality.

The Teacher-in-Residence program features an academic year's university residency for a secondary teacher. The teacher studies a new area of mathematics, teaches university mathematics classes, directs student teachers, and promotes curriculum articulation between university and secondary schools.

BACKGROUND AND NEEDS

The profession of mathematics teaching must be upgraded. All teachers must be given the opportunity and the responsibility to be full members of the mathematics education community, to continue to develop professionally, to develop curricula and plan school policies and, as faculty, to exercise educational leadership within their schools. In short, the entire community of teachers must both be viewed and view themselves as professional mathematicians and educators. Teachers so prepared not only are superior classroom teachers, they are much less likely to leave the profession.

At the national level this need has been recognized for teachers at all levels and in all disciplines. Throughout the current movement of education reform the need for a discipline-based, pedagogically sound, professionally-oriented faculty has been recognized as a key element. One influential report identifying this need has been "A Nation Prepared: Teachers for the 21st Century" sponsored by the Carnegie Forum on Education and the Economy. This report elicited an open letter, in August, 1987, from 37 college and university presidents urging their fellow presidents to become actively involved in reforming the nation's schools. This group stated that "the compelling argument of [A Nation Prepared] is that better schools require higher quality teachers, teaching must become a true profession". The President's group went on to conclude that they sensed an unprecedented opportunity to change the nature of teaching and the

teaching profession. The following views were expressed in their letter:

- relationships between schools and universities must reflect a "mutuality of interest" and they encouraged "forms of collaboration that are genuinely mutual" such as appointing "Master Teachers" to positions on university faculties.

- universities should make a new commitment to improving teacher preparation, and such improvement needs to involve education school and arts and science faculty.

- the need for able, well-prepared minority teachers, especially in the urban schools, is desperate.

- teacher preparation programs and continuing professional development must be based on "organic relationships" between schools and universities.

This open letter and "A Nation Prepared" reflect views that have been enunciated throughout the school reform movement.

The nature of the profession of teaching has also been seen as key by the national mathematics community. Virginia Commonwealth University has participated in this dialogue. The Consortium for Mathematics and its Applications, which initially was concerned with applications at the university level, began publishing CONSORTIUM with the explicit goals of encouraging school teachers to view themselves as professional mathematicians and fostering collaborative activities between university and school faculties.

Members of Virginia Commonwealth University's Teacher Professional Network have participated in editing and writing for this publication. With support from the National Science Foundation, the American Mathematics Project has been created to encourage university and school faculty to work together to improve mathematics learning. The Virginia Commonwealth University Mathematics Teacher Professional Network has been chosen as a mentor project and will assist in the development of such activities by the Northwest Tennessee Mathematics Project. The National Council of Teachers of Mathematics has been actively engaged in attempting to raise the level of the profession. Their journal, Mathematics Teacher, featured a report on "Virginia Commonwealth University Mathematics Teacher-in-Residence Program" in the September, 1987, issue.

Major needs among currently certified secondary school mathematics teachers in Virginia are for: 1) increased in-service training in those areas of mathematics which are of increasing importance; 2) more opportunities for their professional growth as mathematicians and as teachers of mathematics; and 3) mechanisms to encourage secondary school classroom teachers to play a leadership role in a collegial, ongoing program providing professional growth and constructive exchange of ideas between university and secondary school faculty. These needs are especially important since the substantial majority of persons who will be teachers of mathematics in the year 2000 are teaching now. With the time-consuming, arduous day-to-day responsibilities of

secondary school teachers, it is difficult to find time to rediscover the joy and excitement of mathematics, to share successful teaching experiences with others, or to learn important, new developments in the applications of mathematics. Many teachers are unaware of emerging areas of mathematics that are being introduced into the secondary school curriculum. Periodic, one-shot activities cannot, in themselves, satisfy these needs. The need for such activities became apparent to the faculty of Virginia Commonwealth University in recent years through its involvement with the Greater Richmond Council of Teachers of Mathematics and the Virginia Council of Teachers of Mathematics, through previous sponsorship of a series of National Science Foundation programs for mathematics teachers, and more recently through participation in programs helping teachers trained in other areas to meet endorsement requirements in mathematics. It is recognized that teachers of inner-city students and of gifted and talented students particularly need the specific training and collegial support offered by the project. Teachers within the former group find themselves faced day-by-day with the necessity to provide compensatory instruction or other special actions. These efforts on the part of teachers are constraints upon their professional involvement, and the focus of their instruction may reduce the extent to which they identify with the mathematics community, particularly the broader community encompassing university faculty. Teachers of gifted and talented students particularly need the stimulation and collegial ties aspired to by the project.

PROJECT DESCRIPTION

Artificial barriers exist between secondary school and university mathematics programs and faculty. Too often university faculty are unaware of the teaching innovations occurring at the secondary school level. Too often secondary school faculty often lose touch with new developments in mathematics and cease to grow professionally. Virginia Commonwealth University's School-University Mathematics (SUM) program is designed to break down these barriers by providing ongoing opportunities for collegial activities among university and school mathematics faculty members.

The purpose of the SUM program is: to develop collegial relationships between university mathematics faculty and secondary school mathematics teachers and through these relationships improve the content of mathematics courses and the teaching of mathematics at both the secondary and university levels; to increase articulation between the mathematics curricula at the secondary and university levels; and to nurture the personal, professional growth of mathematics educators at both levels.

The basic assumptions underlying the program are that university and school mathematics teachers are part of the same mathematics education community; that school faculty will profit from engaging in professional activities as mathematicians; and that faculty and programs at both levels will profit from cooperative, collegial relationships between the faculties.

These underlying assumptions led to the development of the major components of the SUM program, namely, cooperatively developed

and instructed mathematics courses, collegial participation in sharing with the mathematics community ideas concerning mathematics and the teaching of mathematics, and the Virginia Commonwealth University Mathematics Teacher-in-Residence Program.

Each summer since 1985 the Mathematics Colloquium has brought together approximately twenty secondary school teachers, four school system mathematics supervisors and ten Virginia Commonwealth University mathematics and mathematics education faculty. The week-long colloquium includes presentations concerning recent trends in mathematics curriculum, discussions concerning the teaching of mathematics, and lectures on mathematics and the history of mathematics. Participants from schools and the university prepare each other to play leadership roles in the mathematics community. The 1988 Summer Colloquium brought together secondary teachers and university faculty from three other regions around the state to work with participants of the SUM program to initiate similar programs in their areas.

In a sense, the Mathematics Colloquium is a microcosm of the entire SUM program which features school and university faculty working and learning together in a collegial setting. In another sense, the Mathematics Colloquium provides a springboard for the broader activities of the program which involve many more participants. These activities include planning for specific in-service training programs for prospective teachers, developing college level courses for the continuing education of practicing teachers, and formulating future activities.

A major component of the SUM program has been the development and offering of college credit and in-service courses for practicing teachers of mathematics. Practicing teachers of mathematics profit most from mathematics courses that are both intellectually challenging and that address topics that are directly relevant to the secondary school curriculum. A team consisting of university faculty who are active in the discipline and school faculty who have current experience in the secondary school classroom is uniquely prepared to develop, prepare and offer such courses. This model has been followed in the following courses which have been structured and offered since 1984: "Applications of Computers in the Teaching of Mathematics" (developed and taught by four secondary school and one university faculty - offered twice); "Discrete Mathematics" (non-college credit course developed and taught by four secondary and one university faculty - offered once); "Functions, Sequences, Series and Their Applications" (developed and taught by four secondary and two university faculty - offered once, to be repeated in 1989); "Symmetry, Rigid Motions and Patterns" (developed and taught by one secondary and one university faculty). Teams of school and university faculty also developed a new course on "Critical Thinking and Problem Solving in Mathematics" which was offered as a sequence of three one-credit modules in 1987.

In addition, eight other courses have been developed and offered specifically for prospective and current teachers of mathematics under a variety of different arrangements. Most recently, a college credit course was developed for in-service teachers based

on the telecourse-video series "For All Practical Purposes" produced by the Annenburg CPB Project. This course is currently being taught at four sites around the state. Each offering is team taught by a university faculty member and four secondary teachers. Much of the this activity has been supported by competitive grants received under the Education for Economic Security Act, Title II.

The school-university partnership which has been developed is further strengthened through the selection each year, beginning with 1986-87, of the Virginia Commonwealth University Mathematics Teacher-in-Residence. During the academic year of residency, the selected teacher studies a new area of mathematics in depth, teaches two university mathematics classes each semester, assists in supervising student teachers, and shares ideas concerning mathematics and the teaching of mathematics with current and prospective secondary teachers and with Virginia Commonwealth University faculty. Finally, the teacher is asked to identify additional areas of need for cooperation between secondary school and universities and to play an active role in organizing and planning the summer mathematics colloquium.

RESULTS

The climate of supporting collegial relations between school and university faculty, as well as the particular components of the program, have led to additional outcomes: school and university teachers have grown professionally; there have been significant changes in the teaching of mathematics at the secondary and uni-

versity levels. A leadership group of secondary school teachers and university faculty has been developed. Secondary school participants in the program have made over twenty presentations at local, state and national meetings; over twenty-five teaching articles, book reviews, critiques of computer software and mathematics papers have appeared in local, state and national publications. For example, a team consisting of one secondary school and one university faculty member has developed an ongoing research program in mathematics resulting in published mathematics research; a team consisting of three secondary school and two university faculty has written and illustrated a general interest cartoon mathematics book; a team headed by one university and one secondary school faculty is reviewing new supplemental materials for the national Consortium for Mathematics and Its Applications.

Changes have been made in teaching of mathematics at the secondary level. Teachers are better prepared to discuss topics in discrete mathematics, functions, sequences and series, and probability and statistics. Computer software which has been identified, critiqued and catalogued has helped improve the teaching of mathematics. The teachers' enthusiasm for mathematics is shared with their students.

There have also been changes in Virginia Commonwealth University curriculum. The university is much better prepared to offer a mathematics curriculum for prospective school teachers. Topics prepared for the continuing education courses have been integrated into the regular curriculum. Plans are underway to review the

entire teacher training curriculum. In addition, there have been changes at the freshman level. University faculty are better aware of the background of entering students. Computer-assisted instruction materials prepared for high school students have been found to be valuable at the university level, and plans are underway to offer computer-assisted instruction in the university freshman-level program.

CONCLUSIONS AND RECOMMENDATIONS

The School-University Mathematics program is as much an attitude as it is a set of activities. The collegial relationships developed with the enthusiastic support of local secondary school systems (both public and private) and the university administration will continue to strengthen and enliven mathematics both in the secondary schools of central Virginia and at Virginia Commonwealth University.

The current project focus of the SUM program is on identifying a cadre of exemplary teachers and preparing this group of master teachers to serve as Clinical Faculty who will work collaboratively with faculty in Virginia Commonwealth University's Mathematics Teacher Preparation Program. The goal of this project is to use Clinical Faculty support to ensure that all new teachers will continue to learn new mathematics, will view themselves as members of the mathematics community which includes secondary and university faculty, will share with others their ideas and experiences concerning the teaching of mathematics and thereby become mathematics education professionals.

Clinical Faculty will have demonstrated leadership roles through their activities in the nationally-recognized Greater Richmond Area Teacher Professional Network (TPN). As an extension of the collegial, collaborative activities of the TPN, this group of outstanding mathematics faculty will be prepared to play an ongoing role in all aspects of Virginia Commonwealth University's Mathematics Teacher Preparation Program. They will work with Virginia Commonwealth University's mathematics and mathematics education faculty in updating the program; teach components of mathematics and mathematics education courses; serve as role models for new teachers; and work with student teachers. The outcome of the program, which will serve a total of 150 individuals, will be evaluated and analyzed for potential effectiveness as a national model for enhancing the teaching profession.

VIRGINIA COMMONWEALTH UNIVERSITY
Mathematics Teacher-in-Residence Program

TEACHER-IN-RESIDENCE: Universities have long drawn upon the expertise of professionals and artists through various programs as Writer-in-Residence, Artist-in-Residence, and Executive-in-Residence. Individuals participating in these programs have shared their expertise and insights with university faculty and students and in turn have departed from the university with new knowledge, experience and renewed vigor. The Virginia Commonwealth University Mathematics Teacher-in-Residence is a program offered within the Department of Mathematical Sciences which provides many of the same benefits in the area of mathematics education.

THE NEED: There is a growing national recognition that the profession of teaching must be substantially upgraded. All teachers need to be well grounded in their academic disciplines. Teachers need to be aware of the skills and knowledge required by their student's prospective employers. The talents and expertise of the most highly skilled and experienced teachers must be made available to other members of the teaching staff. Strong links need to be developed between secondary school teachers, Schools of Education faculty, and mathematics faculty.

UNIVERSITY/SCHOOL PARTNERSHIP: The effort to improve the teaching of mathematics requires the participation of outstanding secondary and college faculty. College faculty are aware of newly discovered mathematics and of new applications of mathematics. In addition they are aware of particular uses of mathematics across the university curriculum. They are regularly engaged in the creation of new mathematics and in sharing new discoveries and insights with their peers. On the other hand, the most highly skilled and experienced teachers are aware of the challenge of teaching mathematics at the secondary level. They are well aware of the portions of the curriculum that students find most difficult and of the areas where knowledge of new applications would be most useful. The best teachers will have managed to have continued to learn new mathematics and to have retained an interest in and excitement for mathematics, but they also will be aware of the obstacles that teachers must overcome in order to continue to grow in this way. Working together, university faculty and outstanding secondary school teachers can take important steps toward upgrading the teaching profession and improving the teaching of mathematics.

CURRENT INITIATIVE: Building upon a long-established base of training and retraining mathematics teachers, supporting local and national mathematics teachers organizations, and sponsoring high school mathematics contests, the Virginia Commonwealth University Mathematical Sciences Department is currently engaged in a long-range mathematics leadership development program. This Teacher Professional Network is sponsored by the University through direct and in-kind support, area school systems through in-kind support, and the State Council of Higher Education for Virginia under the Education for Economic Security Act I, Title II.

A major thrust of the leadership development program is the sponsoring of an annual Summer Mathematics Colloquium. The annual colloquium assembles approximately nine Virginia Commonwealth University mathematics and mathematics education faculty and approximately 25 secondary school teachers and mathematics supervisors. During the Colloquium participants share ideas and experiences concerning new mathematics, new applications of mathematics, and new methods of teaching mathematics. Each participant prepares to play a leadership role in the mathematics community through writing for local and national publications, through speaking at local, regional or national mathematics meetings, and/or through conducting or assisting in-service training sessions and mathematics courses for fellow teachers. In addition, the needs of mathematics teachers are assessed and strategies are developed to best meet these needs.

SELECTION OF TEACHER-IN-RESIDENCE: The Teacher-in-Residence is selected from among the secondary mathematics teachers who participate in the Summer Mathematics Colloquium. The selection is made by the Mathematical Sciences Department faculty members who participate in the colloquium. Criteria for selection include overall reputation for excellence as a teacher and possession of at least a Masters Degree. The teacher spends one academic year at Virginia Commonwealth University.

ASSIGNMENT OF TEACHER-IN-RESIDENCE: During the period of residence the teacher teaches two university mathematics classes each semester. Typically these are classes taken by recent high school graduates. The Teacher-in-Residence compares expectations of the college course with subjects taught in typical preparatory secondary school courses.

The teacher also studies a new area of mathematics in depth, either by taking university mathematics classes or by participating with university faculty in ongoing research projects. Typically, topics studied are in areas that are under consideration for addition to the secondary school curriculum. Possibilities include discrete mathematics, applications of mathematics, numerical algorithms, and statistics.

The Teacher-in-Residence is expected to share ideas concerning mathematics and the teaching of mathematics with current and prospective teachers. Possibilities include making presentations in teaching methods classes, team teaching VCU mathematics courses designed for teachers, and participating in in-house training sessions for teachers.

Finally, the teacher is asked to identify additional areas of need for cooperation between secondary schools and universities. In particular, the Teacher-in-Residence helps maintain the vitality of the leadership development program by providing a link between university and school faculty.

ANTICIPATED OUTCOMES: In addition to annually providing the opportunity for a secondary mathematics teacher to grow professionally, learn new mathematics, and to better understand the mathematical requirements of various university programs, the dual effect will be to better acquaint university mathematics faculty with the secondary school mathematics curriculum and how well it prepares students for particular topics at the university level. Other secondary teachers are expected to receive the benefit of direct interactions with the Teacher-in-Residence through training sessions and instructional classes.

It is anticipated that a long-term outcome of the program will be to help diminish barriers between university and secondary school mathematics communities in the areas of curriculum coordination and professional interaction. The individuals who have served as Teachers-in-Residence will provide a cadre of exemplary secondary school teachers who have a strong commitment to the continual mathematical growth of all mathematics teachers. Working with school administrators and university faculty they will help to develop a strong, supportive, professional climate for all teachers of mathematics and, in so doing to, upgrade the teaching of mathematics at all levels.